High power NIR laser bar with improved beam quality

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High Power NIR Laser Bar with Improved Beam Quality

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High power diode laser bars are interesting light sources for, e.g., in the graphics industry due to their small physical size (in the order of cubic milli metres), high output power levels (up to 100W) and long life time (more than 10000 hours). But the major drawback of these sources are the poor beam quality in the freely running mode due to a broad emitting junction.

An efficient method for improving the beam quality of laser bars is, Off Axis Spectral Beam Combining (Ref. 1). The light from various emitters is combined using a reflecting grating and made to travel in parallel to each other using a plane output coupler (Ref.2). In addition to this, a few modes are fed back to the laser using a high reflective D shaped mirror. The experiments on a NIR laser bar yielded an output beam of 5.4 watts of output optical power at 20A of operating current and the measured M^2 values of the combined beam from 13 emitters were 1.9 and 3.5 for the fast and the slow axes respectively. Comparing these results to that obtained from simple spectral beam combining, the beam quality along the slow axis was improved by a factor of 30 without any reduction in the output power.

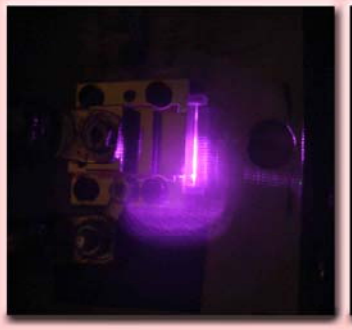


Fig. 1 Photograph of FHG 15811 with Off Axis Spectral beam combining

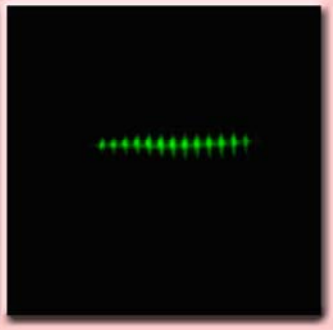
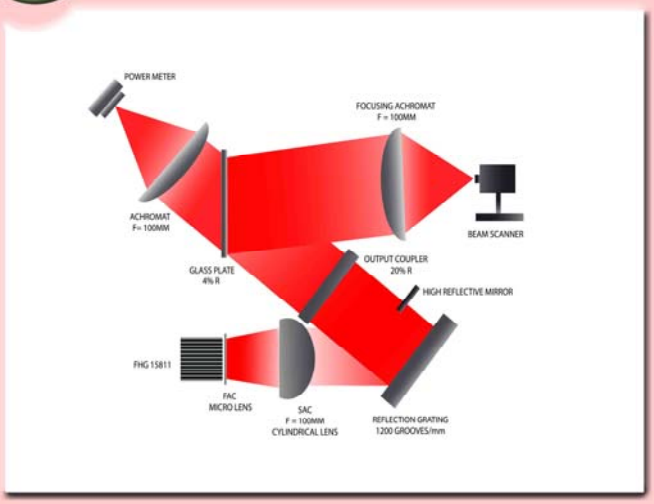


Fig. 2 Near Field Photograph of the of the laser

Fig. 3 Experimental Set up of Off Axis Spectral Beam Combining



Results of Off Axis Spectral Beam Combining on FHG 15811 Laser Bar

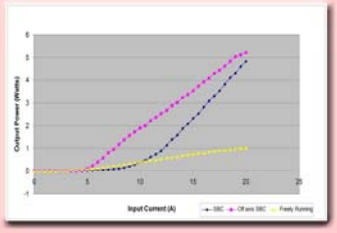


Fig.4 Comparison of Light Current Characteristics

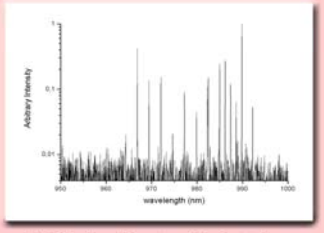


Fig. 5 Wavelength Spectrum of the Output Beam

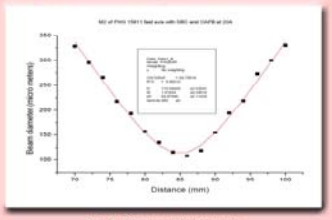


Fig. 6 M^2 along the fast axis

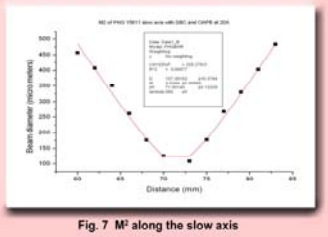


Fig. 7 M^2 along the slow axis

System Specifications:

Laser wavelength	: 980nm.
Fast Axis Collimation	: Micro lens LIMO FAC – 850D lens with f = 910 micro metres.
Slow Axis Collimation	: Cylindrical lens f = 100mm.
Reflection Grating	: Gold Coated with 1200grooves/mm.
Output Coupler	: 20 % Reflective.
Focusing Lens	: Achromat f = 100mm.
Operating Current	: 20A.

System Dimensions:

Laser facet to the SAC lens	: 91mm.
The SAC lens to the grating	: 115mm.
The grating to the output coupler	: 120mm.
The D shaped mirror to the Grating	: 70mm

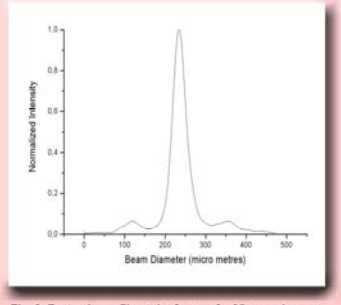


Fig. 8 Fast axis profile at the focus of a 35mm achromat

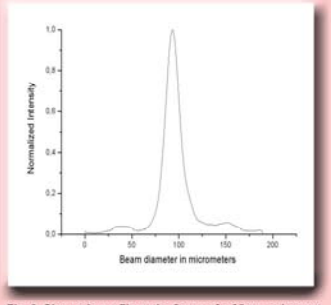


Fig. 9 Slow axis profile at the focus of a 35mm achromat

Summary:

A novel Laser system has been setup based on the Off Axis Spectral Beam Combining of a 980 nm 19 emitter Laser bar. The system delivered an output power of 5.4 Watts at an operating current of 20A. The output exhibited a good beam quality with an M^2 value of 1.9 and 3.5 on the fast and the slow axes respectively. The system output is also tunable within a range of 945 - 995 nm. Currently this work is progressing and attempts are being made to improve the output power without much degradation in the beam quality.

Experimental Results:

Output Optical Power	: 5.4 Watts
Fast Axis M^2 Value	: 1.9
Slow Axis M^2 Value	: 3.5
Output Wavelength	: 945 - 995 nm

References:

1. *O.B. Jensen, B. Thestrup, P.E. Andersen, P. M. Petersen, Appl. Physics. B. 83, 225- 228 (2006).*
2. *V. Daneu, A. Sanchez, T. T Fan, H. K. Choi, G. W. Turner, C. C. Cook, Optics Letters, Vol. 25, No. 6, 405- 407 (2000).*

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